FACTORS AFFECTING PURITY OF CROP SEEDS IN KANSAS

by

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INTRODUCTION

The purpose of this study is to analyze and evaluate the various factors affecting purity in seed of the major crops produced in Kansas in 1945, and to determine means of reducing loss due to these factors.

Purity of crop seeds refers to their relative freedom from weed seeds, foreign material, seeds of other crops, and seeds of other varieties of the same crop. The Federal Seed Laws of 1940 and the seed laws of the various states are uniform in their use and interpretation of the term purity.

Seed laws define and classify four kinds of weed seeds: prohibited, limited, noxious, and common.

In Kansas and most other states, prohibited weed seed constitutes the impurity most important to producers of crop seeds, since seed containing any prohibited weed seed cannot be offered for sale. Weeds defined as prohibited are: field bindweed (*Convolvulus arvensis*), hoary cress (*Lepidium draba*), Russian knapweed (*Centaurea picris*), and leafy spurge (*Euphorbia esula*).

Limited weed seeds are those that, when present in a crop to the extent of more than one seed per ten grams, will prevent the crop seed from being sold for planting purposes. Such weeds are Johnson grass (*Sorghum halepense*) and dodder (*Cuscuta sp.*).

Weeds are considered noxious when their habits of growth are such that they are difficult to eradicate, or when they materially reduce the crop yield, or when they are poisonous to livestock. Such weeds the farmer particularly wants to keep off his land. Crop seed containing noxious weeds in excess of .1 percent cannot be sold unless there appears on the label the name and number per pound of each kind of weed seed. Classified as noxious weeds are the following: Johnson grass (*Sorghum halepense*), dodder, (*Cuscuta sp.*), buckhorn plantain (*Plantago lanceolata*), wild mustard (*Brassica sp.*), French weed (*Thalaspi arvense*), quackgrass (*Agropyron repens*), wild onion (*Allium sp.*), curled dock (*Rumex sp.*), bull nettle (*Solanum carolinense*), wild carrot (*Daucus carota*), chess or cheat (*Bromus sp.*), ox-eye daisy (*Chrysanthemum leucanthemum*), hedge bindweed (*Convolvulus sepium L*), and annual morning glory (*Ipomoea sp.*).

The classification known as common weeds includes those recognized by law, official regulations, or general usage simply as weeds. There are probably more than 400 species of plants found in Kansas which are generally recognized as weeds (Gates, 1941) and about one-fourth of these were noted in the crop seeds studied for this thesis.

A second type of impurity is the seeds of plants grown locally as crops, other than the kind under consideration. If wheat is the crop being tested for purity, seeds of oats, rye, flax, barley, etc., are termed as other crops and therefore impurities.

Inert material, or foreign material, named under impurity includes broken seeds (when one-half or less is present), seed coats, soil, stones, chaff, fungus bodies (such as ergot and smut balls), and any other kind of matter which will not grow.

Underdeveloped and badly injured weed seeds which upon visual examination appear clearly incapable of growth are also classified as inert matter.

Since the mechanical removal of impurities is of the utmost importance in seed growing, screens and other mechanical devices have been studied and will be discussed later.

REVIEW OF LITERATURE

The main sources of information used for this report have been the Annual Reports of the State Seed Laboratory. In fact very little other literature concerning this subject can be found. These annual reports furnish many interesting points for comparison.

The following is taken from a table in the Twenty-first Annual Report.

Table 1. Number and kind of seeds tested and results for the year ending June 30, 1946.

Kind	No. of tests	Av. percent purity	Excess dodder	Excess J. G.	Field Bindweed	Hoary cress
		Section A. Unofficial samples*				
Alfalfa	937	95.28	96		1	
Barley	125	98.29		2	2	
Red clover	161	95.82	60			
Sweet clover	447	97.63	2		3	
Flax	103	95.92	3		1	
Bromegrass	406	75.76			4	
Lespedeza	209	94.68	97			
Millet	179	97.09			1	
Oats	996	98.36			52	1
Rye	100	97.58				
Soybeans	208	97.58				
Sudan	589	95.21			4	
Wheat	1562	99.61				

Table 1 (concl.).

Kind	No. of tests	Av. percent purity	Excess dodder	Excess J. G.	Field Bindweed	Hoary cress
		Section B. Official samples*				
Alfalfa	38	93.95	5			
Barley	1	94.71				
Red clover	5	96.89	1			
Sweet clover	13	97.54			4	
Flax	1	99.28				
Bromegrass	11	83.21				
Lespedeza	7	98.50	3			
Millet	15	98.31				
Oats	64	97.91		2	18	
Soybeans	13	96.84				
Sudan	62	96.85				
Wheat	3	98.36				

*Official samples are collected by inspectors of the Control Division, State Board of Agriculture. Unofficial samples are sent in by any grower or dealer.

Stewart (1916), in a review of the seed situation in Utah, found that the farmers of that state lost many thousand dollars annually as a result of the use of poor seed. Individual farmers often suffered losses amounting to several hundred dollars.

For the production of good crops it is essential to start with good seed, since the new plant is a direct descendant of the plant from which it came. A plant cannot develop beyond its potentialities. Possibly the easiest gain in crop improvement could be made by focusing attention upon the quality of the seed.

Listed below is an outline of objectionable features.

- A. Seed true to kind
  - 1. Mature
    - a. Alive
    - b. Dead
  - 2. Immature
    - a. Shrunken seeds
    - b. Empty hulls
- B. Seeds of other crops and other varieties of the same crop
- C. Inert material
  - 1. Earth
    - a. Small gravel
    - b. Dust
  - 2. Organic
    - a. Broken stems
    - b. Chaff
    - c. Manure
- D. Injured seeds
  - 1. Broken kernels
  - 2. Blemished kernels
    - a. Diseased
    - b. Frosted
    - c. Hard shelled
    - d. Insect injury
    - e. Soaked
- E. Weeds
  - 1. Noxious

a. Common

b. Not common

2. Not noxious

Impurities are not constant in all samples but vary both as to kind and amount present. Some of the seed damage is due to lack of care in handling or storage, but other kinds of damage may be due to unfavorable conditions that man cannot control.

Some estimates of the cost to the farmer of impure seeds were made by Stewart (1916). He found that clover seed costing about $4.50 a bushel on the market contained so many impurities that to obtain a bushel of clean seed from the various lots would have cost anywhere from $4.50 to $23.65. It would have cost from $1.62 to $57.25 to obtain a bushel of pure timothy seed from lots of seed selling at $1.35 to $1.60 per bushel. A pound of pure red top seed obtained from lots that sold for 5.4 cents to 13.7 cents per pound would have cost from 17.7 cents to 81.3 cents per pound. This shows that in many instances a low grade seed is more expensive in the long run than a better grade of seed.

The same investigator pointed out that additional labor is required to remove weeds that are present as a result of weed seed planted with the crop seed. If not removed, the weeds not only lower the yield and reduce the quality and market value of the crop, but also increase the labor of harvesting.

The seeds of many species of weeds are so small that it is difficult to realize how many might be present even in a single pound of seed. In an average sample of alfalfa tested by the Utah Seed Laboratory, weeds accounted for only one-fifth of one percent of the total weight, but on this basis there would have been 990 weed seeds for each pound of crop seed. In another instance a particularly bad sample, sown at the usual rate would have distributed the equivalent of 5,000,000 weed seeds to the acre. If four-fifths of these grew, nearly one hundred weeds would feed from each square foot of soil in the entire field. Manifestly little else could exist on the same area.

Poor seed may also introduce weeds that may be noxious or prohibited, such as Canada thistle, Russian thistle, bindweed, tumbling mustard, or dandelion. It pays the farmer to inspect seeds, irrigation water, etc., for these weeds are more easily kept out of a field than eradicated after they become established. Damage of this type is serious, for it may result in anything from a slight to a total loss. In some instances weeds have compelled farmers to stop growing certain crops.

The following impurities seem to be found commonly in the various crop seed (Norris, 1940).

In alfalfa, dodder is a noxious weed which is often present, as well as seeds of many kinds of common weeds. Sweet clover and yellow trefoil seeds are found frequently. The empty perforated seed coats indicate the work of the chalcid fly.

In general, the points mentioned under alfalfa also apply to red clover. Buckhorn plantain, a noxious weed seed, may be present too.

The noxious weed seeds likely to be present in Korean lespedeza are dodder, horse nettle, and curled dock. Soil particles are also common.

In Sudan grass, two species of noxious weed seeds, Johnson grass and field bindweed, are often present. Seeds of sorghums are sometimes present.

Seeds of Johnson grass, field bindweed, and annual morning glory are the noxious weed seeds most likely to be found in sorghums.

The presence of rye is fairly common in wheat. Seeds of field bindweed, chess or cheat may be present also.

The seed of chess or cheat are almost universally present in Kansas grown bromegrass seed. Northern grown seed may contain seeds of quackgrass. Excessive amounts of inert matter consisting of chaff, broken stems, empty glumes, and leaves may be present.

The presence of seeds of field bindweed, annual morning glory and horse nettle may occur in soybeans and cowpeas. The inert matter is composed largely of broken seeds and soil particles.

MATERIAL AND METHODS

Fourteen crops were studied for this report; namely: alfalfa, barley, bromegrass, flax, lespedeza, millet, oats, red clover, rye, sorghum, soybeans, Sudan grass, sweet clover, and wheat. The purity analysis system, based on the Rules and Recommendations for Testing Seeds (1938) and records at the Kansas State Seed Laboratory, were used.

The equipment used in making purity tests usually consists of balances (analytical and torsion), lens (reading, hand, and binocular), forceps, dividers, screens, sieves, blowers, small fanning mill, and record cards.

Method of Purity Testing. When a sample of seed is received from the farmer or dealer, the first step is to determine the kind of seed. After this is done, the sample is thoroughly mixed and a working sample is obtained by successively cutting down the original sample with the divider. The portion upon which a detailed analysis is made varies in weight with various crops. It is approximately the weight of 3000 seeds of the crop under consideration.

The working sample is weighed on a torsion balance with sensitivity of .01 gram. The weights of the working sample of various crops are given below.

1. One gram is used for redtop, bluegrass, and Bermuda grass.

2. Two grams are used for timothy, orchard grass, alsike and white clover, and Reed canary grass.

3. Five grams are used for ryegrass, meadow fescue, foxtail millet, alfalfa, red clover, sweet clover, lespedeza, and bromegrass.

4. Ten grams are used for flax.

5. Twenty-five grams are used for proso millet and sudan grass.

6. Fifty grams are used for sorghum.

7. One hundred grams are used for corn, beans, peas, cowpeas, wheat, oats, rye, and barley.

If noxious weeds are present, a supplementary sample should be analyzed to determine the kinds and number per pound of these weeds. This should consist of approximately 25 grams for redtop, bluegrass, and Bermuda grass. For timothy, orchard grass, alsike clover, white clover, ryegrass, meadow fescue, foxtail millet, alfalfa, red clover, sweet clover, lespedeza, bromegrass, and flax a 50 gram sample should be used. One hundred fifty grams make an adequate sample for proso millet and sudan grass. Three hundred grams for sorghum, and 500 grams for corn, beans, peas, cowpeas, and soybeans are sufficient.

The working sample should be run over an appropriate screen or sieve before hand separation is attempted. By removing the stems, seeds, etc., that are not the same size as the crop in question, this screening saves much time in hand picking. A specially designed verticle blast blower is used sometimes to remove such light material as chaff, glumes, immature seeds, etc. These screenings are checked and their proportions recorded.

The actual hand separation should be done under a reading glass in the case of small seeds, such as alfalfa, sweet clover, and blue grass. The working sample is placed upon a white or yellow background, and a few seeds at a time are examined. These may be re-examined as often as necessary to remove all impurities. In the process of examination, the working sample is separated by means of forceps into four portions: (1) pure seed, (2) weed seed, (3) other crop seed, and (4) inert matter. Soil, sand, chaff, smut, ergot, broken seeds, seeds with seed coats removed, and empty and sterile glumes of grasses are considered inert matter. In the case of broken seeds any piece larger than one-half is considered pure seed, while one-half or less is considered inert.

The separations are carefully weighed in order to determine the percentage of pure seed, weed seed, other crop seed, and inert material, and then placed in small envelopes to be filed for future reference.

When noxious weeds are present, the supplementary sample is used from which are determined the number of noxious weed seeds present per pound. This determination is made by multiplying the number of noxious weed seeds found by 454.4 grams (the number of grams per pound) and dividing by the weight of the sample in grams.

All that the law requires on the purity report is the percentage of pure seed, weed seed, inert, other crops, and the name and number of noxious weed seeds per pound. However, on the laboratory working slip, the kind of weed seed (both common and noxious), and the kind of inert matter are recorded in detail. These recorded data have been used to a great extent in this report.

Summarizing the Reports. The purity cards from the laboratory were classified according to crops and the information recorded on them was tabulated. The weight of weeds, other crops, inert material, and total weights were tabulated. This was done so that the average weight per sample could be calculated, and the percentage of impurities, other crops, inert material, and weeds could be determined. The number of samples containing each of the components of these three main factors were tabulated and summarized. These tabulations are shown in Tables 3 to 8.

RESULTS

The results below are a summary of the information presented in Tables 3 to 8.

Alfalfa. The first crop to be considered in this study is alfalfa, of which 948 samples were analyzed. Of these 75.85 percent contained weed seeds of 43 different species, and 19.09 percent contained seeds of other crops, while inert material was found in all the samples. Impurities constituted 4.41 percent of the total weight of seed, and of that amount, 314 percent was inert material and 0.18 percent was other crops. Inert material comprised 71.83 percent of the impurities, while only 24.10 percent was weed seeds and 4.06 percent was other crops.

Inert material occurred in a greater number of samples than any other form of impurity. In spite of its prevalence, inert matter is the least objectionable of all the impurities. It was present in all alfalfa samples with an average of 3.14 percent per sample and represented 71.83 percent of the total weight of all impurities. Cracked seed was the most important single constituent of the inert material and was present in 86.92 percent of all samples. Next in importance were stems in 51.92 percent, soil in 47.7 percent, and chaff in 12.42 percent of the samples. Small amounts of excreta, hulls, glumes, pods, rocks, lime, leaves, and seed coats were found in that order.

Weed seed ranked second and represented 24.10 percent of the total impurities by weight. Weed seeds were present in 73.85 percent of the samples. The kind as well as the weight and number of weed seeds must be considered in evaluating the importance of that impurity. One sample contained field bindweed, a prohibited weed. Limited weeds may be as objectionable as prohibited weeds if they are in excessive amounts. In this case 13.18 percent of the samples contained dodder, 11.74 percent contained the weed in excess of one seed in ten grams. Johnson grass was found in 1.05 percent of the samples.

Curled dock was next in abundance of the noxious weeds, being present in 19.51 percent of the samples. Other noxious weed seeds were bull nettle with 5.90 percent, annual bromegrass with 4.74 percent, and wild mustard with 0.105 percent.

Common weeds are harmful because they reduce yield as well as purity. Among those found, green foxtail was the most prevalent in alfalfa and occured in 61.49 percent of the samples. Green foxtail seed is about the same size as alfalfa and is difficult to remove with cleaning machinery. For this reason, it is the most widespread of the common weeds found in alfalfa. Pigweed was next in importance with 25.10 percent, followed by switchgrass with 25.00 percent, crabgras 12.65 percent, barnyard grass 9.48 percent, ragweed 9.26 percent, Russian thistle 9.17 percent, lambsquarter 7.70 percent, and prickly sida 7.17 percent. The following had between five percent and one percent from highest to lowest in order: princpsis, dotted millet, Mexican fireweed, paspalum, buffalo bur, common plantain, sandbur, Brown-eyed Susan, smartweed, Texas crabgrass, sedge, vervain, and spurge. The following occured in fewer than one percent of the samples: Pennsylvania smartweed, wild buckwheat, old witchgrass, blue sage, three seeded mercury, wild rye, switchgrass, fanweed, velvet leaf, peppermint, mallow, croton, and marsh elder.

Other crop seed was present in 19.09 percent of the samples, with an average of 0.18 percent per sample, and constituted 4.06 percent of the total weight of impurities. Other crops occur in the order one might expect. Sweet clover was present in 13.18 percent of the samples, and was followed by red clover in 11.70 percent, lespedeza in 3.48 percent, millet in 1.68 percent, alsike clover and timothy in 0.95 percent each, wheat in 0.73 percent, Sudan in 0.52 percent, sorghum in 0.42 percent, flax in 0.32 percent, rye and white clover in 0.21 percent each, and barley, and crested wheatgrass in 0.105 percent each.

Barley. One hundred thirty samples of barley were analyzed of which 10.76 percent contained weed seeds of 17 different species, and 53.84 percent contained seeds of other crops. Inert material was prssent in all samples. All impurities constituted 1.70 percent of the total weight of seed. Of all impurities 1.09 percent was inert material, 0.52 percent was other crops, and 0.01 percent weed seeds. Inert material constituted 89.45 percent of the impurities, while 35.22 percent was other crops, and only 0.59 percent was weed seeds.

Inert material was the most prevalent impurity. It was found in all samples, with an average of 1.09 percent per sample, or 64.19 percent of the total weight of impurities. Cracked seed was present in 76.92 percent of the total samples, followed by stems in 39.93 percent, glumes in 31.53 percent, chaff in 23.84 percent, soil in 10.00 percent, leaves in 5.38 percent, excreta in 1.53 percent, and stems in 0.76 percent.

Other crops were found in 53.84 percent of the samples for an average of 0.52 percent per sample and constituted 35.22 percent of the weight of the impurities. Oats is considered the worst crop impurity found in Kansas barley and this report indicatss why it is so considered. It was present in 21.53 percent of the samples, followed by wheat in 14.16 percent, sorghum in 12.30 percent, and rye in 7.69 percent. Of lesser importance was alfalfa in 3.08 percent of the samples, red clover in 2.30 perosnt, lespedeza in 2.30 percent, Sudan grass in 1.53 percent, sweet clover, bromegrass, and soybeans in 0.76 percent each.

Weeds are of minor importance in barley, being present in only 10.76 percent of the samples with an average of 0.01 percent per sample and constituted 0.59 percent of the total weight of the impurities. There were no prohibited or limited weeds in the samples analyzed. The most prevalent noxious weed was cheat. It was found in 5.38 percent of the samples, followed by curled dock in 2.30 percent and wild mustard in 0.76 percent.

Common weeds are not numerous in barley and seem to be present because they grow well in Kansas rather than because of any similarity in size and shape of seed. This would indicate that with better cleaning of seed, most of the remaining weeds could be eliminated. Pigweed was present in 6.93 percent of the samples, followed by sunflower in 2.30 percent, lambsquarter in 1.53 percent, green foxtail in 1.53 percent, blue sage, peppergrass, witchgrass, yellow foxtail, barnyard grass, wild barley, mallow, wild buckwheat, Russian thistle, and wild rose in 0.76 percent each.

Bromegrass. Four hundred fifteen samples of bromegrass were analyzed of which 89.88 percent contained weed seed of 37 different species, and 65.30 percent contained seed of other crops. Inert material was present in all the samples. Impurities constituted 24.23 percent of the total weight of the seed. Of this amount 15.61 percent was inert, 7.26 percent was weed seed, and 1.38 percent was other crops. Inert matter constituted 64.41 percent of the impurities while 29.91 percent was weed seed and 5.68 percent was other crops.

Inert material was found in all the samples with an average of 15.61 percent per sample, constituting 64.41 percent of the total weight of impurities. Glumes were present in 76.62 percent of the samples, stems in 40.70 percent, leaves in 31.08 percent, chaff in 9.15 percent, cracked seeds in 6.98 percent, pods in 2.41 percent, excreta in 2.17 percent, and soil, grass, ergot, and awns in less than one percent.

Weeds were second in frequency, being present in 89.88 percent of the samples with an average of 7.26 percent per sample. This constituted 29.91 percent of the total weight of impurities. Field bindweed was found in 1.44 percent of the samples, and since it is a prohibited weed it was the most important single factor. Dodder occured in 1.68 percent of the samples but was not in excess of one per ten grams in any of them. Noxious weeds were very numerous in cultivated bromegrass. Cheat occured in 81.44 percent of the samples, probably due to the fact it is very hard to separate from cultivated bromegrass. Curled dock was present in 49.87 percent of the samples, wild mustard in 1.20 percent, and horse nettle in 0.24 percent.

Common weeds were overshadowed in amount by noxious weeds in bromegrass. Wild rye leads the list of common weeds being present in 7.95 percent of the samples, followed by pigweed, yellow foxtail, lambsquarter, and smartweed in 2.89 percent each. Wild lettuce and barnyard grass were slightly less with 2.65 percent respectively, followed by little barley with 2.17 percent, common plantain with 1.94 percent, and buffalo bur, and wild buckwheat with 0.95 percent each. Dotted millet, sunflower, wild oats, evening primrose, paspalum, witchgrass, wild licorice, prinopsis, sedge, Texas crabgrass, quackgrass, bull thistle, Brown-eyed Susan, mallow, stinkgrass, shepards purse, and five fingers was present in less than one percent of the samples.

Other crop seed was present in 65.30 percent of the samples with an average of 1.38 percent per sample and constituting 0.86 percent of the total impurities. Sweet clover was present in 46.50 percent of the samples, wheat in 20.48 percent, alfalfa in 18.07 percent, oats in 14.93 percent, rye in 6.98 percent, timothy in 7.74 percent, red clover in 4.57 percent, sorghum in 1.90 percent, crested wheatgrass in 1.68 percent, flax, ryegrass, lespedeza in 1.44 percent each, millet in 1.20 percent, and orchard grass, white clover, western wheatgrass, barley, Sudan grass, corn, slender wheatgrass, canary grass, and meadow fescue were present in less than one percent.

Flax. Eighty-eight samples of flax were analyzed of which 60.22 percent contained weed seed of 30 different species, and 27.27 percent contained seeds of other crops. Inert material was present in all the samples. Impurities constituted 4.35 percent of the total weight of seed. Of this amount 3.90 percent was inert, 0.29 percent weed seed, and 0.16 percent other crop seed. Inert material constituted 89.45 percent of the impurities, while only 6.78 percent was weed seed and 3.77 percent was other crops.

Inert material which was the principal impurity was present in all the samples with an average of 3.91 percent per sample and constituted 89.45 percent of the total impurities. The most prevalent component of the inert fraction was cracked seed in 81.81 percent of the samples, followed by stems in 52.27 percent, chaff in 9.08 percent, pods and glumes in 1.14 percent each.

Weeds were present in 60.22 percent of the samples with an average of 0.29 percent per sample and constituted 6.78 percent of the total impurities. Field bindweed was present in 1.14 percent of the samples and excess dodder occured in 3.40 percent of them, thus preventing the crop containing these weeds from being sold. Dodder was present in 15.90 percent of the samples but not in excessive amounts in all of them.

Noxious weeds were common in flax. Curled dock was present in 47.72 percent of the samples, followed by horse nettle in 32.95 percent, cheat in 31.81 percent, and wild mustard in 26.13 percent.

Fewer common weeds were found in flax. Green foxtail was present in 21.59 percent of the samples, Brown-eyed Susan in 18.18 percent, barnyard grass and Pennsylvania smartweed in 14.77 percent each. Crabgrass in 10.22 percent, and smartweed in 9.08 percent. Pigweed was present in 7.95 percent of the samples, yellow foxtail and lambsquarter in 6.14 percent each, sage in 3.40 percent, sunflower, evening primrose, false flax, common plantain, and button weed in 2.73 percent each. Small peppergrass, witchgrass, ragweed, wild buckwheat, paspalum, wild rose, and wild lettuce were present in 1.14 percent each.

Other crops were present in 27.27 percent of the samples with an average of 0.16 percent per sample and constituted 3.77

percent of the impurities. Sweet clover was present in 15.90 percent of the samples, wheat in 9.08 percent, alfalfa in 7.95 percent, oats and lespedeza in 4.54 percent each. Sudan in 3.40 percent, millet in 2.27 percent, rye in 2.27 percent, and crested wheatgrass, bromegrass, soybeans, and sorghum in 1.14 percent each.

Lespedeza. Two hundred five samples of lespedeza were analyzed of which 95.60 percent contained weed seed of 38 different species, and 18.53 percent contained seed of other crops. Inert material was present in all the samples. All impurities constituted 4.86 percent of the total weight of the seed, and of this amount 1.73 percent was seeds and 0.15 percent was other crops. Of the impurities inert material constituted 61.27 percent, while 33.50 percent was weeds and 3.11 percent was other crops.

Inert material was present in all the samples analyzed with an average of 2.98 percent per sample and constituted 35.50 percent of the total weight of the impurities. Cracked seed was present in 57.07 percent of the samples, stems in 54.18 percent, soil in 39.02 percent, chaff in 36.58 percent, hulls in 3.90 percent, pods in 3.90 percent, leaves in 2.93 percent, seed coats in 1.95 percent, and glumes in 0.97 percent.

Weeds were present in 95.60 percent of the samples with an average of 1.73 percent per sample and constituted 35.50 percent of the total impurities. Dodder was present in 61.95 percent of the samples but in excessive amounts in only 42.92 percent. Johnson grass was present in 1.46 percent of the samples. Other noxious weeds were present in the following amounts: curled dock in 42.43 percent, cheat in 39.02 percent, and horse nettle in 25.85 percent. Common weeds were also numerous in lespedeza. Witchgrass was present in 52.19 percent of the samples, ragweed in 51.21 percent, crabgrass in 30.24 percent, barnyard grass in 24.39 percent, sunflower in 16.08 percent, mallow in 11.21 percent, smartweed and prickly sida in 10.73 percent each, Pennsylvania smartweed in 9.26 percent, pigweed in 8.78 percent, beggars tick in 3.41 percent, spurge, dotted millet, buffalo bur, vervain and button weed with 1.95 percent each, sedges and three seeded mercury in 1.46 percent each, prickly pear and marsh elder in 0.98 percent, blue sage, wood sage, Indian hemp, sandbur, wild rose, and stinkgrass in 0.49 percent each.

Other crops were present in 18.53 percent of the samples with an average of 0.15 percent per sample and constituted 3.11 percent of the total impurities. Sweet clover was present in 7.31 percent of the samples, alfalfa in 4.39 percent, oats in 2.92 percent, red clover in 2.43 percent, flax in 1.95 percent, millet in 0.98 percent, bromegrass, timothy, and Sudan grass in 0.49 percent each.

Millet. One hundred ninety-five samples of millet were analyzed of which 63.07 percent contained weeds of 29 different species, and 16.97 percent contained seed of other crops. Inert material was present in all the samples. Impurities constituted 3.40 percent of the total weight of the seed. Of this amount 2.25 percent was inert material, 0.62 percent was weed seed and 0.17 percent was other crops. Inert material constituted 74.10

percent of the impurities while 20.60 percent was weed seed and 5.30 percent was other crops.

Inert material was present in all the samples with an average of 2.25 percent per sample and constituted 74.20 percent of the total weight of impurities. Cracked seed was present in 47.17 percent of the samples, glumes in 31.79 percent, soil in 15.38 percent, stems in 7.69 percent, chaff and hulls in 3.06 percent each, excreta in 2.56 percent, and smut balls in 0.51 percent.

Weeds were present in 63.07 percent of the samples with an average of 0.62 percent per sample and constituted 20.60 percent of the total impurities. Field bindweed was present in 0.50 percent of the samples and was the only prohibited weed found. Johnson grass was found in 0.51 percent of the samples. Noxious weeds were more numerous. Curled dock was present in 5.63 percent of the samples, horse nettle in 3.06 percent, cheat in 1.53 percent, and morning glory in 1.02 percent.

Common weeds were much more numerous than noxious weeds. Green foxtail was present in 45.12 percent of the samples, pigweed in 41.02 percent, witchgrass in 25.64 percent, crabgrass in 14.35 percent, buffalo bur in 13.30 percent, lambsquarter in 13.33 percent, Brown-eyed Susan in 12.82 percent, barnyard grass in 9.23 percent, ragweed in 5.63 percent, blue sage in 5.12 percent, spurge in 4.61 percent, smartweed in 4.10 percent, sunflower, prickly sida, ground cherry, and dotted millet in 2.56 percent each, stinkgrass, Russian thistle, and sandbur in 1.53 percent each. Yellow foxtail, marsh elder, mallow, croton, and

Mexican fireweed were present in 0.51 percent of the samples each.

Other crops were present in 16.97 percent of the samples with an average of 0.17 percent per sample and constituted 5.30 percent of the total impurities. Alfalfa was present in 14.35 percent of the samples, sorghum in 8.71 percent, Sudan in 6.66 percent, wheat in 6.15 percent, sweet clover in 5.63 percent, oats in 2.56 percent, lespedeza and flax in 1.02 percent each, and alsike clover, corn and barley in 0.51 percent each.

Oats. One thousand thirteen samples of oats were analyzed of which 30.90 percent contained weeds of 36 different species, and 52.12 percent contained seed of other crops. Inert material was present in all the samples. All impurities constituted 1.41 percent of the total weight. Of this amount 0.91 percent was inert, 0.04 percent weed seeds, and 0.45 percent other crop seeds.

Inert material was present in all the samples with an average of 0.91 percent per sample and constituted 64.30 percent of the total weight of impurities. Glumes were present in 54.49 percent of the samples, chaff in 43.92 percent, stems in 41.85 percent, cracked seeds in 34.84 percent, awns in 16.28 percent, soil in 9.37 percent, leaves in 5.83 percent, excreta in 1.79 percent, hulls in 0.49 percent, and string in 0.09 percent.

Weeds were present in 30.98 percent of the samples with an average of 0.04 percent per sample and constituted 3.40 percent of the total impurities. Prohibited weeds were numerous in oats. Field bindweed was present in 4.73 percent of the samples and hoary cress in 0.09 percent. In the limited weed class Johnson grass was present in 0.19 percent of the samples. Noxious weeds were also numerous in oats. Cheat was present in 27.64 percent of the samples, curled dock in 25.36 percent, wild mustard in 5.43 percent, hedge bindweed in 1.28 percent, horse nettle in 0.79 percent, and morning glory in 0.19 percent.

Common weeds were not as important as noxious weeds. Wild buckwheat was present in 7.24 percent of the samples, green foxtail in 3.85 percent, peppergrass in 2.96 percent, pigweed in 2.86 percent, wild rose in 2.46 percent, Pennsylvania smartweed in 2.07 percent, Brown-eyed Susan in 1.48 percent, wild barley in 1.27 percent, wild oats in 0.59 percent, sedge in 0.59 percent, blue sage and barnyard grass in 0.49 percent; ragweed, wild rye, cleavers, wild geranium, evening primrose, and stinkweed in 0.19 percent each; sandbur, hemlock, mallow, ground cherry, velvet leaf, common plantain, wood sorrel, witchgrass, and quackgrass in 0.09 percent each.

Other crops were present in 53.12 percent of the samples with an average of 0.45 percent per sample and constituted 32.30 percent of the total weight of impurities. Wheat was the most prevalent of the other crops found, being present in 39.58 percent of the samples, barley in 31.49 percent, sweet clover in 12.53 percent, lespedeza and flax in 1.77 percent each, corn in 1.27 percent, red clover in 0.88 percent, Sudan in 0.59 percent, and bromegrass in 0.49 percent. Millet, rescue grass, ryegrass, and white clover were present in a few samples also.

Red Clover. One hundred seventy-eight samples of red clover were analyzed of which 64.60 percent contained weed seeds of 29 different species, and 24.72 percent contained seeds of other crops. Inert material was present in all the samples. Impurities constituted 3.95 percent of the total weight of the seed. Of this amount 2.67 percent was inert, 1.04 percent was weed seeds and 0.24 percent other crop seeds. Inert material constituted 67.40 percent of the impurities while 26.40 percent was weeds and 6.20 percent was other crops.

Inert material was present in all the samples with an average of 2.67 percent per sample and constituted 67.40 percent of the total weight of the impurities. Cracked seeds were present in 15.80 percent of the samples, stems in 35.39 percent, soil in 27.52 percent, chaff in 14.60 percent, glumes in 1.12 percent, excreta, ergot, hulls, pods, and stones in 0.56 percent each.

Weeds were present in 64.60 percent of the samples with an average of 1.04 percent per sample and constituted 26.40 percent of the total impurities. No prohibited weeds were found in red clover; but dodder was in excess in 27.08 percent of the samples, and was present in 37.60 percent of all samples. Noxious weeds were numerous. Curled dock was present in 33.14 percent of the samples, cheat in 11.80 percent, horse nettle in 11.23 percent, buckhorn plantain in 7.33 percent and wild mustard in 0.56 percent.

Common weeds present were as follows: green foxtail in 26.24 percent of the samples, prickly sida in 14.05 percent, crabgrass in 11.23 percent, pigweed in 9.48 percent, witchgrass in 8.43 percent, ragweed in 7.86 percent, buffalo bur in 6.18 percent, Pennsylvania smartweed in 5.06 percent, ground cherry and common plantain in 4.32 percent, smartweed and paspalum in 2.80 percent, wild buckwheat and sedge in 1.68 percent, lambsquarter and Brown-eyed Susan in 1.12 percent, and mallow, rushgrass, prinopsis, Mexican fireweed, dotted millet and vervain in 0.56 percent each.

Other crops were present in 24.72 percent of the samples with an average of 0.24 percent per sample and constituted 6.20 percent of the total impurities. Alfalfa was present in 21.34 percent of the samples, sweet clover in 16.85 percent, lespedeza in 8.43 percent, timothy in 6.74 percent, alsike in 3.37 percent, white clover in 2.80 percent, wheat, flax, millet in 1.68 percent each, White Dutch clover and oats in 1.12 percent, ryegrass, western wheatgrass, corn, barley, bluegrass, and rye in 0.56 percent each.

Rye. Ninety-seven samples of rye were analyzed of which 42.26 percent contained weed seed of 17 different species and 59.79 percent contained seeds of other crops. Inert material was present in all of the samples. Impurities constituted 2.12 percent of the total weight of the seed. Of this amount 1.11 percent was inert material, 0.37 percent was weed seed, and 0.64 percent was other crop seed. Inert material constituted 51.70 percent of the impurities while 17.70 percent was weed seeds and 30.09 percent was other crop seed.

Inert material was present in all the samples with an average of 1.11 percent per sample and constituted 51.70 percent of the total weight of impurities. Cracked seed was present in 71.13 percent of the samples; followed by stems in 16.49 percent, glumes and chaff in 16.49 percent each, leaves in 15.46 percent, soil in 6.18 percent, ergot in 3.09 percent, and pods in 1.03 percent.

Noxious weeds present were: cheat in 25.77 percent, curled dock in 18.55 percent, horse nettle in 2.06 percent, and morning glory and wild mustard in 1.03 percent of the samples. Common weeds were less prevalent, with no species occuring in more than 1.03 percent of the samples. Those present were smartweed, green foxtail, pigweed, evening primrose, wild barley, Pennsylvania smartweed, wild geranium, peppergrass, barnyard grass, goat grass, wild buckwheat, and dotted millet.

Other crops were present in 59.79 percent of the samples with an average of 0.64 percent per sample and constituting 30.60 percent of the impurities. Wheat was present in 25.77 percent of the samples, sweet clover in 15.46 percent, oats in 15.46 percent, barley in 6.18 percent, sorghum in 5.16 percent, bromegrass and alfalfa in 3.09 percent each, lespedeza in 2.06 percent, millet, flax, vetch, and Sudan grass in 1.03 percent each.

Sorghum. Three thousand four hundred samples of sorghum were analyzed, 11.94 percent of which contained weed seeds of 33 different species, and 52.73 percent contained seed of other crops. Inert material was present in all the samples. All impurities constituted 4.18 percent of the total weight of the seed. Of this amount 3.90 percent was inert, 0.01 percent was weed seed, and 0.27 percent was other crop seeds. Inert material constituted 93.31 percent of the impurities, while 0.24 percent was weeds, and 6.45 percent was other crops.

Inert material was present in all the samples with an average of 3.90 percent per sample and constituted 93.31 percent of the total impurities. Cracked seeds were present in 70.97 percent of the samples, glumes in 67.29 percent, stems in 13.46 percent, smut balls in 4.82 percent, soil in 3.61 percent, excreta in 2.70 percent, chaff in 1.23 percent, awns in 0.44 percent, hulls and leaves in 0.17 percent each, immature seeds, seed coats and rocks in small amounts.

Weeds were present in 11.94 percent of the samples with an average of 0.01 percent per sample and constituted 0.24 percent of the total impurities. There were no prohibited weeds present. Johnson grass was the only limited weed present and was found in 0.50 percent of the samples. Annual morning glory was present in 18.52 percent of the samples, cheat in 0.58 percent, curled dock in 0.09 percent, horse nettle in 0.06 percent, and wild mustard in 0.03 percent.

Common weeds present were: pigweed in 8.36 percent, sunflower in 6.29 percent, ragweed in 1.00 percent, Russian thistle in 0.82 percent, buffalo bur in 0.79 percent, velvet leaf in 0.71 percent, green foxtail in 0.58 percent, Pennsylvania smartweed in 0.35 percent, Brown-eyed Susan in 0.23 percent, witchgrass in 0.21 percent, lambsquarter in 0.15 percent, blue sage in 0.18 percent, Jimson weed in 0.09 percent, wild buckwheat, barnyard grass, peppergrass, and elephant-tusk in 0.06 percent each. Mexican fireweed, prinopsis, spurge, wild licorice, black niteshade, crabgrass, wild barley, mallow, marsh elder, Mexican sandbur, and sticktight were present in 0.03 percent each.

Other crops were present in 52.73 percent of the samples with an average of 0.27 percent per sample and constituted 6.45 percent of the total impurities. Other sorghums were present in 50.47 percent of the samples, wheat in 13.44 percent, Sudan in 6.55 percent, oats in 2.55 percent, barley in 2.18 percent, alfalfa in 1.65 percent, sweet clover in 0.85 percent, rye in 0.74 percent, millet in 0.71 percent, cheat in 0.35 percent, lespedeza in 0.26 percent, corn in 0.26 percent, flax in 0.15 percent, red clover in 0.10 percent, ryegrass, soybeans, and alsike clover in 0.03 percent each.

Soybeans. Two hundred two samples of soybeans were analyzed, 17.32 percent of which contained weed seeds of 26 different species, and 20.79 percent contained seeds of other crops. Inert material was present in all of the samples. All impurities constituted 2.42 percent of the total weight of the seed. Of this amount 2.33 percent was inert, 0.03 percent was weed seed, and 0.06 percent was other crops. Inert material constituted 96.30 percent of the impurities, while 1.20 percent was weed seed, and 2.50 percent was other crops.

Inert material was present in all the samples with an average of 2.33 percent per sample and constituted 96.30 percent of the total weight of the impurities. Cracked seed was present in 72.20 percent of the samples, hulls in 59.40 percent, soil in 18.81 percent, stems in 8.91 percent, seed coats in 2.97 percent, glumes in 1.98 percent, immature seed in 0.99 percent, and leaves in 0.49 percent of the samples.

Weeds were present in 17.32 percent of the samples with an average of 0.03 percent per sample and constituted 1.20 percent of the total impurities. Weeds were of little importance in soybeans. Morning glory was present in 16.36 percent of the samples, horse nettle in 2.47 percent, and cheat in 0.49 percent. Pennsylvania smartweed, present in 9.90 percent of the samples, was the principal common weed, followed by ragweed with 7.42 percent, cone flower in 4.59 percent, velvet leaf in 3.46 percent, buffalo bur in 2.97 percent, sunflower in 2.47 percent, barnyard grass in 1.98 percent, green foxtail and prickly sida in 1.48 percent each, marsh elder in 0.99 percent, evening primrose, Jimson weed, blue sage, Brown-eyed Susan, wild rose, smartweed, ground cherry, sandbur, button weed, stickseed, puncture vine, and devil's claw in 0.49 percent each.

Other crops were present in 20.79 percent of the samples with an average of 0.06 percent per sample and constituted 2.50 percent of the total impurities. Sorghum was present in 15.84 percent of the samples, wheat in 7.42 percent, oats in 5.94 percent, alfalfa and corn in 3.46 percent, Sudan in 2.97 percent, lespedeza in 2.47 percent, sweet clover in 1.98 percent, flax, cowpeas, and brome grass in 0.99 percent each, red clover, barley, rye, timothy, and alsike clover into 0.49 percent each.

Sudan Grass. Five hundred twelve samples of Sudan grass were analyzed of which 50.39 percent contained weed seed of 41 different species, and 61.32 percent contained seeds of other crops. Inert material was present in all the samples. Impurities constituted 4.66 percent of the total weight. Of this amount 4.18 percent was inert, 0.14 percent was weed seed, and

0.28 percent other crop seed. Inert material constituted 90.50 percent of the impurities while 3.20 percent was weed seed, and 6.30 percent was other crops.

Inert material was present in all the samples with an average of 4.18 percent per sample and constituted 90.50 percent of the impurities. Glumes were present in 92.97 percent of the samples, cracked seed in 79.29 percent, stems in 58.96 percent, excreta in 18.36 percent, soil in 14.06 percent, chaff in 9.57 percent, smut balls in 5.47 percent, hulls in 1.37 percent, awns in 0.78 percent, leaves in 0.59 percent, stones in 0.39 percent and pods in 0.19 percent.

Weeds were present in 50.39 percent of the samples with an average of 0.14 percent per sample and constituted 3.20 percent of the total impurities. Field bindweed was present in 0.59 percent of the samples, and Johnson grass in 1.15 percent of the samples. Noxious weeds present were: cheat in 3.15 percent of the samples, horse nettle in 0.96 percent, curled dock in 0.96 percent, wild mustard in 0.59 percent, hedge bindweed in 0.39 percent, and morning glory in 0.39 percent.

Common weeds present were: Pigweed in 45.12 percent, sunflower in 20.88 percent, buffalo bur in 17.50 percent, green foxtail in 15.82 percent, Russian thistle in 8.23 percent, ragweed and smartweed in 7.03 percent each, witchgrass in 6.25 percent, Brown-eyed Susan in 5.83 percent, crabgrass in 5.08 percent, Pennsylvania smartweed in 3.71 percent, lambsquarter in 3.51 percent, velvet leaf in 3.32 percent, and blue sage in 3.15 percent of the samples. The following weeds occur in less than one percent of the samples: Marsh elder, spurge, Mexican fireweed, niteshade, Jimson weed, stinkgrass, ground cherry, common plantain, wild lettuce, button weed, prickly sida, prinopsis, dotted millet, evening primrose, peppergrass, paspalum, sandbur, tickseed, and beggars tick.

Other crops were present in 61.62 percent of the samples with an average of 0.28 percent per sample and constituted 6.30 percent of the total impurities. Sorghums were present in 39.25 percent of the samples, wheat in 23.61 percent, oats in 15.04 percent, alfalfa in 11.91 percent, millet in 11.91 percent, sweet clover in 7.61 percent, rye in 5.08 percent, lespedeza in 2.32 percent, flax in 1.75 percent, corn in 1.37 percent, bromegrass in 0.96 percent, and red clover in 0.18 percent.

Sweet Clover. Three hundred twelve samples of sweet clover were analyzed, 82.40 percent of which contained weed seeds of 36 different species, and 10.56 percent contained seeds of other crops. Inert material was present in all the samples. All impurities constituted 3.15 percent of the total weight of the seed. Of this amount 2.91 percent was inert, 0.13 percent was weed seed and 0.11 percent was other crop seed. Inert material constituted 92.20 percent of the impurities, while 4.30 percent was weed seed, and 3.50 percent was other crop seed.

Inert material was present in all the samples with an average of 2.91 percent per sample and constituted 92.20 percent of the total weight of the impurities. Cracked seeds were present in 94.13 percent of the samples, stems in 36.65 percent, chaff in 25.21 percent, soil in 19.35 percent, pods and hulls in

8.79 percent each, leaves, grass, and excreta in 2.93 percent each.

Weeds were present in 82.40 percent of the samples with an average of 0.13 percent per sample and constituted 4.30 percent of the total impurities. Field bindweed, a prohibited weed, was present in 0.88 percent of the samples. Dodder was present in 2.34 percent but was not in excess in any of them. Noxious weeds also were numerous. Curled dock was present in 56.87 percent of the samples, cheat in 23.46 percent, buckhorn plantain in 0.88 percent, and wild mustard in 0.29 percent.

Common weeds were not present in as many samples as were noxious weeds. Green foxtail was present in 13.48 percent of the samples, witchgrass in 4.39 percent, vervain and pigweed in 2.63 percent, buffalo bur in 1.46 percent, common plantain in 1.17 percent, lambsquarter, prinopsis, ground cherry, dragon headed mint, and sedge in 0.88 percent each, Pennsylvania smartweed, prickly sida, Brown-eyed Susan, cleavers, mallow, wood sage, and catchfly were present in 0.29 percent each.

Other crops were present in 10.56 percent of the samples with an average of 0.11 percent per sample and constituted 3.50 percent of the total impurities. Alfalfa was the principal other crop in sweet clover, probably due to the fact that its seed size corresponds to that of sweet clover. It was found in 8.50 percent of the samples followed by lespedeza in 4.98 percent, red clover in 4.38 percent, oats in 3.22 percent, millet in 1.46 percent, flax in 1.46 percent, wheat, timothy, and rye in 1.17 percent each, Sudan in 0.88 percent, bromegrass in 0.58 percent, ryegrass, orchard grass, alsike clover, and sorghum in 0.29 percent.

Wheat. Fifteen hundred twenty two samples of wheat were analyzed, 15.87 percent of which contained weed seeds of 23 different species, and 10.25 percent contained seed of other crops. Inert material was present in all samples. All impurities constituted 1.07 percent of the total weight. Of this amount 1.02 percent was inert, 0.01 percent was weed seed, and 0.04 percent was seed of other crops.

Inert material was present in all the samples with an average of 1.02 percent per sample and constituted 95.40 percent of the total impurities. Cracked seed was present in 89.22 percent of the samples, glumes in 23.71 percent, stems in 6.57 percent, chaff in 5.71 percent, awns in 2.16 percent, soil in 1.97 percent, leaves in 1.44 percent, excreta in 0.65 percent, stones in 0.38 percent, and smut balls in 0.12 percent.

Weeds were present in 15.87 percent of the samples with an average of 0.01 percent per sample and constituted 0.50 percent of the total impurities. Cheat, a noxious weed, was present in 9.31 percent of the samples, while curled dock was present in 1.63 percent. Common weed seeds were rare in wheat. Pigweed was present in 1.11 percent of the samples, wild buckwheat in 0.54 percent, witchgrass in 0.39 percent, green foxtail, peppergrass, and lambsquarter in 0.32 percent each. The following weeds were present in a few samples: Pennsylvania smartweed, evening primrose, cleavers, wild rose, wild geranium, crabgrass, wild rye, spurge, sunflower, smartweed, hedge mustard, bull thistle, dotted millet, common plantain, and corn cockle.

Other crops were present in 10.05 percent of the samples with an average of 0.04 percent per sample and constituted 4.10 percent of the total impurities. Oats was present in 7.72 percent of the samples, sorghum in 3.21 percent, sweet clover in 2.12 percent, barley in 1.31 percent, rye in 1.11 percent, alfalfa and bromegrass in 0.39 percent, flax and red clover in 0.12 percent, and Sudan, meadow fescue, and soybeans in 0.06 percent.

General Experimental Results. Inert material was found in all samples studied, and was present in greater amounts than weeds or other crops. It ranged from a high of 15.61 percent of the total weight in bromegrass to a low of 0.91 percent in oats. Cracked seed was the main inert material, followed by glumes, stems, soil, chaff, leaves, excreta, hulls, awns, pods, rocks, smut, lime, seed coats, ergot, immature seeds, grass, string, and glass.

Weeds are the most important factor even though they rank second to inert material in amounts. Bromegrass contained the greatest percentage of weeds with an average of 7.26 percent per sample. Sorghum and wheat had the lowest percentage of weed seeds with an average of 0.01 percent per sample.

One must consider the type of weed seeds in order to evaluate their importance. Prohibited weeds are the worst type since a crop cannot be sold if these weed seeds are found in it. Field bindweed is the most important prohibited weed in Kansas, being found in 4.73 percent of the oat samples, 1.44 percent of the bromegrass samples, 1.14 percent of the flax samples, 1.08 percent of the sweet clover samples, 0.59 percent of the Sudan samples, 0.51 percent of the millet samples, and 0.11 percent of the alfalfa samples. Unless these weeds are eliminated from the lot, a complete loss is suffered by the grower. Hoary cress, also a prohibited weed, was found in 0.09 percent of the oat samples.

Limited weeds are important because samples containing more than one seed per ten grams are unsaleable. In fact, these weeds caused a greater financial loss to Kansas farmers than did prohibited weeds. This is due to the fact that dodder was in excess in so much of the seed offered for sale. Excess dodder was found in 42.92 percent of the lespedeza samples analyzed, 27.08 percent of the red clover samples, 11.07 percent of the alfalfa samples, 3.40 percent of the flax samples, and 0.58 percent of the sweet clover samples.

Johnson grass, another limited weed, was present in 1.46 percent of the lespedeza samples, 1.15 percent of the Sudan samples, 0.51 percent of the millet samples, 0.50 percent of the sorghum samples, 0.19 percent of the oat samples, and 0.11 percent of the alfalfa samples. However, it was not in excess in any sample.

Noxious weeds were next in importance. Eight species of them, in addition to dodder and Johnson grass, were found in the samples. Wild bromegrass was the most important, followed by curled dock, horse nettle, wild mustard, annual morning glory, hedge bindweed, and buckhorn plantain.

Common weeds are not as harmful as noxious weeds but are more troublesome than other crops and inert material. Seventy-four species of common weeds were found in the 14 crops analyzed. Some were noted in large amounts and some in very small amounts. Green foxtail occurred in the largest numbers, followed by pigweed, switchgrass, lambsquarter and Brown-eyed Susan. The comparative rank of all the weeds is given in Table 6.

Other crops occurred less frequently and in smaller amounts than did weeds and inert, but since they can grow and reproduce they should be considered of more importance than inert material. However, they are not as important as weeds since they do less damage.

Bromegrass contained the greatest amount of other crop impurities, and wheat the least.

Sweet clover was the most prevalent other crop, followed by alfalfa, sorghum, rye, and lespedeza. Table 7 shows that Sudan grass, wheat, flax, bromegrass, oats, red clover, millet, and barley were present in quite large amounts. There were 30 other crops found in the 14 crops studied.

SCREENS FOR CLEANING CROP SEEDS

Screens with various sizes and shapes of perforations were studied for the removal of impurities from different kinds of crop seed. The specifications apply either to hand sieves or to screens in more elaborate cleaning devices such as fanning mills. The findings are recorded in Table 2. The following explanation will aid in understanding the table. Fractions alone as 1/15 or 1/16 refer to the diameter of round perforations expressed in fractions of an inch. Two fractions for the same screen as 1/13 x 1/2 indicate slotted perforations 1/13 inch wide by 1/2 inch long. Whole numbers in all cases are measurements expressed in sixty-fourths of an inch. The use of proper screens along with a suitable air blast will produce cleaner seed.

Table 2. Screens to use for various crops.

Crop	Upper screen	Lower screen
Alfalfa	1/15	6 x 24
Barley	20 or 22	1/13 x 1/2
Soybeans	16 or 18	11/64 x 3/4
Bromegrass	1/13 x 12	6 x 24
Red clover	1/15	6 x 22 or 6 x 24
Sweet clover	1/14	6 x 24
Flax	1/18 x 34	1/13
Lespedeza	6 x 15 or 1/18 x 1/4	1/16
Proso millet	7	1/18 x 1/4
German millet	6	3/64 x 5/16
Oats	11/64 x 34	1/14 x 1/2
Rye	12	1/14 x 1/2
Wheat	14	1/13 x 1/2
Sudan grass	10	3/64 x 5/16

Table 3. The number and percentage of crop samples containing the major factors in purity testing. [1]

Crop	No. of samples analyzed	No. of samples Weeds	No. of samples O.C.	Containing inert	Percent containing weeds	Percent containing O.C.
Alfalfa	948	700	181	948	73.85	19.09
Barley	130	14	70	130	10.76	53.84
Bromegrass	415	373	271	415	89.88	65.30
Flax	88	53	24	88	60.22	27.27
Lespedeza	205	196	38	205	95.60	18.35
Millet	195	122	33	195	63.07	16.97
Oats	1013	313	528	1013	30.80	52.12
Red clover	178	115	44	178	64.60	24.72
Rye	97	41	58	97	42.26	57.79
Sorghum	3400	406	1793	3400	11.94	52.73
Soybeans	202	35	42	202	17.32	20.79
Sudan grass	512	257	314	512	50.39	61.32
Sweet clover	314	281	36	341	82.40	10.56
Wheat	1522	243	153	1522	15.87	10.05

1. Inert material was present in 100 percent of the samples in all cases.

Table 4. Total weight of impurities in samples analyzed.

Crop	Weight of samples (grams)	Weight of impurities (grams)			
	Total	Total	Weeds	O.C.	Inert
Alfalfa	94,800	4285.00	1032.70	172.98	3079.32
Barley	13,000	221.39	1.18	78.08	142.13
Brome grass	41,500	10065.41	3009.78	572.50	6483.13
Flax	8,800	384.28	26.06	14.47	343.73
Lespedeza	20,500	1000.12	356.12	31.16	612.84
Millet	19,500	594.73	120.69	33.20	440.84
Oats	101,300	1432.75	48.56	463.16	921.03
Red clover	17,800	704.84	185.92	43.57	475.35
Rye	9,700	206.91	36.37	63.37	106.92
Sorghum	340,000	14202.86	34.79	916.05	13252.02
Soybeans	20,200	489.01	5.44	12.16	471.41
Sudan	51,200	2368.99	75.51	148.31	2145.17
Sweet clover	34,100	1079.10	46.65	37.73	994.72
Wheat	152,200	1636.20	8.98	67.36	1560.06

Table 5. Average percent impurities per sample by crops.

Crop	Percent of total weight of crop seeds			
	Total impurities	Weeds	O.C.	Inert
Alfalfa	4.41	1.09	.18	3.14
Barley	1.70	.01	.52	1.09
Brome grass	24.23	7.26	1.38	15.61
Flax	4.36	.29	.16	3.90
Lespedeza	4.86	1.73	.15	2.98
Millet	3.04	.62	.17	2.25
Oats	1.41	.04	.45	.91
Red clover	3.95	1.04	.24	2.67
Rye	2.12	.37	.64	1.11
Sorghum	4.18	.01	.27	3.90
Soybeans	2.42	.03	.06	2.33
Sudan	4.60	.14	.28	4.18
Sweet clover	3.15	.13	.11	2.91
Wheat	1.07	.01	.04	1.02

Table 6. Percent of samples containing weeds.

Weeds	Alfalfa	Barley	Brome grass	Flax	Lespedeza	Millet	Oats
	Prohibited weeds						
Field bindweed (Convolvulus arvensis)	0.11		1.44	1.14		0.51	4.73
Hoary cress (Lepidium draba)							0.09
	Limited weeds						
Dodder (Cuscuta sp.)	13.81		1.68	15.90	61.95		
Dodder in excess	11.07			3.40	42.92		
Johnson grass (Sorghum halapense)	0.11				1.46	0.51	0.19
	Noxious weeds						
Cheat grass (Bromus secalinus)	4.74	5.38	81.44	31.81	39.02	1.53	27.64
Curled dock (Rumex crispus)	1.51	2.30	49.87	47.72	42.43	5.63	25.36
Bull nettle (Solanum carolinense)	5.90		.24	32.95	25.85	3.06	.79
Wild mustard (Brassica sp.)	.11	.76	1.20	26.13			5.43
Hedge bindweed (Convolvulus sepium)						1.02	.19
Buckhorn plantain (Plantago lanceolata)							1.28
	Common weeds						
Green foxtail (Setaria viridus)	61.49	1.53	2.89	21.59	30.24	45.12	3.85
Pigweed (Amaranthus sp.)	25.10	6.92	2.89	7.95	8.78	441.02	2.86
Switchgrass (Panicum virgatum)	25.00	.76	.48	1.14	52.19	25.64	.09
Lambsquarter (Chenopodium album)	7.70	1.53	2.89	6.14	3.41	1.33	2.17
Brown-eyed Susan (Hibiscus trionum)	2.00		.24	18.18	9.75	12.82	1.48
Smartweed (Polygonum sp.)	1.79		2.89	9.08	10.73	4.10	1.27
Pa. smartweed (Polygonum pennsylvania)	.52		14.77	9.26		2.07	5.06
Large crabgrass (Digitaria sanguinalis)	12.65		.72	10.22	30.24	14.35	

Table 6 (cont.)

Weeds	Alfalfa	Barley	Brome grass	Flax	Lespedeza	Millet	Oats
Barnyard grass (Echinochloa crusgalli)	9.49	.76	2.41	14.77	24.39	9.23	0.49
Wild buckwheat (Polygonum convolvulus)	.42	.76	.96	1.14			7.42
Sunflower (Helianthus sp.)		2.30	.48	2.27	16.09	2.56	
Ragweed (Ambrosia sp.)	9.28			1.14	51.21	5.63	.19
Mallow (Malva sp.)	.11	.76	.24		11.21	.51	.09
Small peppergrass (Lepidium apetalum)		.76	1.93	3.40	.49		2.96
Dotted millet (Eriochola acuminata)	4.21		.48		1.95	2.56	
Common plantain (Plantago major)	2.53		1.93	2.72			.09
Buffalo bur (Solaum rostratum)			.96		1.95	1.33	
Prickly sida (Sida spinosa)	7.17				10.73	2.56	
Ground cherry (Physalis sp.)	7.17					2.56	.09
Velvet leaf (Abutilon theophrasti)	.21				4.39	1.02	.09
Blue sage (Salvia sp.)	.21	.76				5.12	.49
Evening primrose (Oenothera biennis)			.48	2.27			.19
Prinopsis (Prinopsis ciliata)							
Paspalum (Paspalum ciliatifolium)	3.37		.48	1.14	3.41		
Marsh elder (Iva sp.)	.11				.98	.51	
Wild rose (Rosa sp.)	.76			1.14	.49		2.46
Sedges (Carex sp.)	1.47		.24		1.46		.59
Spurges (Euphorbia sp.)	1.16				1.95	4.61	
Russian thistle (Salsola sp.)	9.17	.76				1.53	
Verbane (Verbane sp.)	1.16		.72		1.95		
Wild barley (Hordeum jubatum)			2.17				1.27
Sand bur (Cenchus tribuloides)	2.32					2.02	.09
Wild rye (Elymus sp.)	.21		7.95				.19
Wild lettuce (Lactuca sp.)			2.65	1.14			
Button weed (Diodia sp.)				2.27	1.95		
Mexican fireweed (Kochia sp.)							.09
Tex. crabgrass (Schedonnardus paniculatus)	1.56		.24				
Yellow foxtail (Setaria glauca)		.76		6.14		.51	

Table 6 (cont.)

Weeds	Alfalfa	Barley	Brome grass	Flax	Lespedeza	Millet	Oats
Stinkgrass (Eragrostis sp.)	.63		.24		.49	2.05	
Dropseed (Sporobolus sp.)	5.69				9.75	1.02	
Wild geranium (Geranium sp.)							.19
Jimson weed (Datura stromonium)							
Three-seeded mercury (Acalypha sp.)	.21				1.46		
Croton (Croton sp.)	.11					.51	
Wild oats (Avena fatua)			.48				.59
Quackgrass (Agropyron repens)			.24				.09
Bull thistle (Cirsium lanceolatum)			.24				
Stickseed (Lappula echinata)							.19
Wood sorrel (Oxalis sp.)							.09
Black niteshade (Solanum nigrum)							
Black-eyed Susan (Rudbeckia hirta)							
Cleavers (Galium sp.)							
Old-witch grass (Panicum capillare)	.32						
Pennycress (Thlaspi arvense)	.21						
Peppermint (Mentha piperita)	.11						
Wild licorice (Glycyrrhiza lepidota			.24				
Shepard's purse (Capsella bursa-pastoris)			.24				
Cinquefoil (Potentilla simplex)			.24				
Small seeded flax (Camelina microcarpa)			.24				
Beggars tick (Bidens sp.)					4.39		
Prickly pear (Opuntia sp.)					.98		
Dogbane (Apocynum cannabinum)					.49		
Poison hemlock (Conium maculatum)							.09
Goat grass (Aegilops sp.)							
Snow-on-the-mountains (Euphorbia marginata)							
Puncture vine (Tribulus terrestris)							
Devils claw (Martynia louisianica)							
Tickseed (Coreopsis sp.)							
Catnip (Nepeta sp.)							

Table 6 (cont.)

Weeds	Alfalfa	Barley	Brome grass	Flax	Lespedeza	Millet	Oats
Lady's thumb (Polygonum persicaria)							
Wood sage (Teucrium canadense)							
Catchfly (Silene sp.)							
Tumbling mustard (Sisymbrium altissimum)							
Corn cockle (Agrostemma githago)							

Table 6 (cont.)

Weeds	Red clover	Rye	Sorghum	Soybeans	Sudan	Sweet clover	Wheat
			Prohibited weeds				
Field bindweed (Convolvulus arvensis)					.59	.88	
Hoary cress (Lepidium draba)							
			Limited weeds				
Dodder (Cuscuta sp.)	37.60					2.34	
Dodder in excess	27.08					.58	
Johnson grass (Sorghum halepense)			.50		1.15		
			Noxious weeds				
Cheat (Bromus secalinus)	11.80	25.77	.58	.49	3.15	23.46	9.31
Curled dock (Rumex crispus)	33.14	18.56	.08		.96	56.87	1.64
Bull nettle (Solanum carolinense)	11.23	2.06	.06	2.47	.96		
Wild mustard (Brassica sp.)	.56	1.03	.03		.59	.29	
Ann. morning glory (Ipomoea sp.)		1.03	1.76	16.36	.39		
Hedge bindweed (Convolvulus sepium)					.39	.88	
Buckhorn plantain (Plantago lanceolata)	7.33						
			Common weeds				
Green foxtail (Seteria viridus)	26.44	1.03	.58	1.48	15.82	13.48	.32
Pigweed (Amaranthus sp.)	9.48	1.03	8.38		45.12	2.63	1.11
Switchgrass (Panicum virgatum)	8.43		.21	2.97	6.25	4.39	.39
Lambsquarter (Chenopodium album)	1.22		.15		3.31	.88	.32
Brown-eyed Susan (Hibiscus trionum)	1.12		.23	.49	5.83	.58	
Smartweed (Polygonum sp.)	2.80	1.03		.49	7.03		.06
Pa. smartweed (Polygonum pennsylvanicum)	1.68	1.03	.06			.29	.54
Large crabgrass (Digitaria sanguinalis)	11.23		.03		5.08	.29	.06
Barnyard grass (Echinochloa crusgalli)		1.03	.06	1.98			

Table 6 (cont.)

Weeds	Red clover	Rye	Sorghum	Soybeans	Sudan	Sweet clover	Wheat
Wild buckwheat (Polygonum convolvulus)	1.68	1.03	.06			.29	.54
Sunflower (Helianthus sp.)			6.29	2.47	20.88	.58	.06
Ragweed (Ambrosia sp.)	7.86		1.00	7.42	7.03		
Mallow (Malva sp.)	.56		.03			.29	
Small peppergrass (Lepidium apetalum)		1.03	.06		.19		.32
Dotted millet (Eriochloa acuminata)	.56	1.03			.19		.06
Common plantain (Plantago major)	4.32				.39	1.17	.06
Buffalo bur (Solanum rostratum)	6.18		.79	2.79	17.50	1.46	
Prickly sida (Sida spinosa)	14.05			1.48	.39	.58	
Ground cherry (Physalis sp.)	4.32			.49	.59	.88	
Velvet leaf (Abutilon theophrasti)			.71	3.46	3.32		
Blue sage (Salvia sp.)			.12	.49	3.15	.58	
Evening primrose (Oenothera biennis)	1.03			.49	.19		.19
Prinopsis (Prinopsis cilliata)	.56		.03		.39	.88	
Paspalum (Paspalum ciliatifolium)	2.80				.19		
Marsh elder (Iva sp.)			.03	.99	.96		
Wild rose (Rosa sp.)		1.03	.03				
Sedges (Carex sp.)	1.68					.88	
Spurges (Euphorbia sp.)	4.49				.78		.06
Russian thistle (Salsola pestifer)			.82	8.23			
Verbane (Verbena sp.)	.56					2.63	
Wild barley (Hordeum jubatum)		1.03	.03				
Sand bur (Cenchus tribuloides)							
Wild rye (Elymus sp.)							.06
Wild lettuce (Lactuca sp.)					.59	.58	
Button weed (Dioda sp.)				.49	.39		
Mexican fireweed (Kochia sp.)	.56		.03		.78	.29	
Tex. crabgrass (Schedonnardus paniculatus)						.58	
Yellow foxtail (Seteria glauca)						.58	
Stinkgrass (Eragrostis sp.)							
Dropseed (Sporobolus sp.)	.56						
Wild geranium (Geranium sp.)		1.03					.12
Jimson weed (Datura stramonium)		.09		.49	.59		

Table 6 (concl.)

Weeds	Red clover	Rye	Sorghum	Soybeans	Sudan	Sweet clover	Wheat
Three-seeded Mercury (Acalypha sp.)							
Croton (Croton sp.)							
Wild oats (Avena fatua)							
Quackgrass (Agropyron repens)							
Bull thistle (Cirsium lanceolatum)							.06
Stickseed (Lappula echinata)				.49			
Wood sorrel (Oxalis sp.)							.58
Black niteshade (Solanum nigrum)			.03		.78		
Black-eyed Susan (Rudbeckia hirta)				4.95		.29	
Cleavers (Galium sp.)						.29	.19
Old-witchgrass (Panicum capillare)							
Frenchweed (Thlaspi arvense)							
Peppermint (Mentha piperita)							
Wild licorice (Glycyrrhiza lepidota)							
Shepard's purse (Capsella bursa-pastoris)							
Cinquefoil (Potentilla simplex)							
Small-seeded flax (Camelina microcarpa)							
Beggars tick (Bindens sp.)							
Prickly pear (Opuntia sp.)							
Dogbane (Apocynum cannabinum)							
Poison hemlock (Conium maculatum)		1.03					
Puncture vine (Tribulus terrestris)			.03				
Goat grass (Aegilops sp.)	1.03						
Devil's claw (Martynia louisiania)				.49			
Tickseed (Corecpsis sp.)					.19		
Catnip (Nepeta sp.)						.88	
Lady's thmmb (Polygonum persicaria)						.29	
Wood sage (Teuorium canadense)						.29	
Catchfly (Silens sp.)						.29	
Tumbling mustard (Sisymbrium altissimum)							.06
Corn cockle (Agrostemma githago)							.06

Table 7. Percent of samples containing other crops.

Other crops	Alfalfa	Barley	Brome grass	Flax	Lespedeza	Millet	Oats
Sweet clover	13.81	.76	46.50	15.90	7.31	5.63	12.53
Alfalfa		3.08	18.07	7.95	4.39	14.35	2.86
Sorghum	.42	12.30	1.93	1.14		8.71	5.82
Rye	.21	7.69	6.98	2.27	1.95	2.05	1.97
Lespedeza	3.48	2.30	1.44	4.54		1.02	1.77
Sudan	.52	1.53	.96	3.40	.49	5.66	.59
Wheat	.73	14.61	20.48			6.15	39.58
Flax	.32		1.44			1.02	1.77
Brome grass	.11	.76		1.14	.49		.49
Oats		21.53	14.93		2.92	2.56	
Red clover	11.70		4.57	9.08	2.43		.88
Millet	1.68	1.53		2.27	.98		.19
Barley	.11		.96			.51	31.49
Corn		.76	.72			.51	1.27
Alsike clover	.95					.51	
Timothy	.95		6.74	.49			
Rye grass			1.44				.09
Soybeans		.76		1.14			
Crested wheatgrass	.11		1.68	1.14			
White clover	.21			.24			.09
Orchard grass			.96				
Western wheatgrass			.96				
Meadow Fescue			.24				
Slender wheatgrass			.48				
Canary grass			.24				
Fescue grass							.19
White Dutch clover							
Bluegrass							
Vetch							
Cowpeas							

Table 7 (concl.)

Other crops	Red clover	Rye	Sorghum	Soy-beans	Sudan	Sweet clover	Wheat
Sweet clover	16.85	15.46	.85	1.98	7.61		2.12
Alfalfa	21.34	3.09	1.65	3.46	11.91	8.50	.39
Sorghum		5.16	50.47	15.84	39.25	.29	3.21
Rye	.56		.74	.49	5.08	1.17	1.11
Lespedeza	8.43	2.06	.26	2.47	2.32	4.98	
Sudan		1.03	6.55	2.97		.88	.06
Wheat	1.68	25.77	13.44	7.42	23.61	1.17	
Flax	1.68	1.03	.15	.99	1.75	1.46	.12
Brome grass		3.09	.35	.99	.96	.58	.39
Oats	1.22	15.46	2.55	5.94	15.04	3.22	7.72
Red clover			.06	.49	.19	4.39	.12
Millet	1.68	1.03	.71		11.91	1.46	
Barley	.56	6.18	2.18	.49			1.31
Corn	.56		.26	3.46	1.37		
Alsike clover	3.37		.03	.49		.29	
Timothy	6.74			.49		1.17	
Rye grass	.56		.03			.29	
Soybeans			.03				.06
Crested wheatgrass							
White clover	2.80						
Orchard grass						.29	
Western wheatgrass	.56						
Meadow Fescue							.06
Slender wheatgrass							
Canary grass							
Rescue grass							.06
White Dutch clover	1.12						
Bluegrass	.56						
Vetch		1.03					
Cowpeas				.99			

Table 8. Percent of samples containing inert material.

Inert material	Alfalfa	Barley	Bromegrass	Flax	Lespedeza	Millet	Oats
							34.84
Cracked seeds	86.92	76.92	6.98	81.81	57.07	47.17	54.49
Glumes	.52	31.53	76.62	1.14	.98	31.79	41.85
Stems	51.69	36.93	40.72	52.27	54.18	7.69	9.37
Soil	41.76	10.00	.72		39.02	15.38	43.92
Chaff	12.42	23.84	9.15	9.08	36.58	3.06	5.82
Leaves	.21	5.38	31.08		2.92		1.97
Excreta	.63	1.53	2.17			2.56	.49
Hulls	.52				3.90	3.60	16.28
Awns		49.23	.24		1.95		
Pods	.52		2.41	1.14	3.90		
Rocks	3.16	.76					
Smut						.51	
Lime	.21						
Seed coats	.21						
Ergot							
Immature seeds			.24				
Grass							
String			.72				.09
Glass							

Table 8 (concl.)

Inert material	Red clover	Rye	Sorghum	Soy-beans	Sudan	Sweet clover	Wheat
Cracked seeds	52.80	71.13	80.97	72.20	79.29	94.13	89.22
Glumes	1.12	16.49	67.29	1.98	92.97	1.46	23.71
Stems	35.39	17.52	13.64	8.91	58.96	36.65	6.73
Soil	27.52	6.18	3.61	18.81	14.06	19.35	1.97
Chaff	14.60	16.49	1.23		9.59	25.21	5.71
Leaves			.17	.49	.59	.29	1.44
Excreta	.56		2.79		18.36	.29	.65
Hulls	.56		.18	59.40	1.37	.88	
Awns			.44		.78		2.16
Pods	.56	1.03		.19	.88		
Rocks					.39		.39
Smut			4.82		5.47		.12
Lime	.56		.03				
Seed coats			.06	2.97			
Ergot	.56	3.09					
Immature seeds			.06	.99			
Grass							
String							
Glass						.29	

DISCUSSION AND CONCLUSIONS

Results of 9,129 tests of 14 different crops were studied and summarized in this report. Inert material, weeds, and other crops were the three main factors taken into consideration in testing for purity. These three may be divided into sub-factors as shown in the preceding tables.

Although inert material was present in the greatest amounts, it was by no means the most objectionable of the impurities, since, as the name implies, it is incapable of growth. It is a hindrance in that it dilutes the pure seed, making it necessary to use more seed per acre when planting. In fact, some samples obtained at the Seed Laboratory contained so much inert material that they would have been of little value for seeding purposes.

Cracked seeds represented the largest single constituent of inert material. This condition of the seed is usually caused by the threshing operations and is difficult to remove from the pure seed. Better screening and blowing would be of help in cleaning the seed, but it is almost impossible to remove all of the cracked seed by mechanical means.

Glumes were the second largest part of inert matter, and were prevalent particularly in crops such as oats. Since glumes are light in comparison to the seeds, some of them may be removed by blowing, although those that are attached to the seeds are very difficult to remove.

Stems rank third in importance among impurities. Sometimes better screening and blowing will remove some of them, but for the most part they are very hard to remove from the sample.

Soil ranks fourth, and is found generally in the smaller seeds, such as alfalfa, lespedeza, red clover, and sweet clover. Apparently the soil is picked up with these seeds during cutting and threshing, and since the seeds are small it is more difficult to clean the samples of this soil.

Following soil in amounts were a number of minor impurities, with chaff and leaves being the greatest. The excreta present was usually that of mice. Hulls, awns, pods, and rocks were found and are self-explanatory. Smut balls were present in some crops, and, although scarce, did show the need for treating some of the crop seeds before planting. Lime and other unidentified chemicals were found, indicating that some of the seed was treated before it was received at the laboratory. Ergot is a disease, but because so very little of it was found, it was not considered an important factor in purity analysis.

A few samples contained immature seeds, indicating that such a condition might become an important factor in such crops as alfalfa. Proper use of a blower will eliminate most of the immature seeds. Grass, string, and glass were present in various crops but need no explanation. Study of Table 8 reveals which crops and in what amounts the inert materials were present.

Weeds, although second in amount to inert material, are much more important from the standpoint of purity. They not only subtract from the percentage of pure seed, as does inert material, but they will grow and reproduce when planted, thus lowering the purity of the succeeding crops even more. Weeds not only increase the cost of production, but increase the cost of harvesting also.

Weeds are divided into four classes: prohibited weeds, limited weeds, noxious weeds, and common weeds. When a crop seed contains a prohibited weed seed, it cannot be offered for sale, resulting in a total loss to the farmer. Crop seeds containing limited weed seeds in excess of one per ten grams cannot be sold either. Noxious weeds must be reported on the label but do not prevent the sale of the seeds. The names of common weeds present in a crop seed are not listed, but the percentage of them is given on the label. Due to their ability to grow and reproduce, they must be considered a more important factor in seed purity than inert material even though they reduce the purity only by the same percentage as a like amount of the latter.

Of the prohibited weeds, field bindweed appears most frequently in the 14 crops studied. It was noted in the largest amounts in oats, being present in 4.73 percent of the samples. Bromegrass contained 1.44 percent, flax contained 1.14 percent, sweet clover 0.88 percent, Sudan grass 0.59 percent, millet 0.51 percent, and alfalfa 0.11 percent. Unless the weed seed is removed this would cause considerable loss to the farmer, but experience has shown removing bindweed to be rather difficult. Hoary cress was found in one sample of oats, but was not seen in any of the other crops. Leafy spurge and Russian knapweed were not found in any of the materials studied.

Dodder was the most important of the limited weeds, causing a great loss in crops such as lespedeza, red clover, and alfalfa, with smaller losses in flax and sweet clover. Dodder was present in 61.95 percent of the lespedeza samples received and was in excess in 42.92 percent of them. Red clover had dodder in excess in 27.08 percent of the samples, alfalfa in 11.07 percent of the samples, flax in 3.40 percent of the samples, and in sweet clover in 0.58 percent of the samples. Dodder was present in 1.68 percent of the bromegrass samples but was not in excess in any of them. From these results it is plain to see that dodder caused the greatest loss of any single impurity in crops.

Dodder is difficult to eradicate from a field of small seeded crops because it grows as a parasite. It entwines itself around the stem and obtains its nutrition from the host plant. Its seed is so nearly the size of those of lespedeza, red clover, alfalfa, and sweet clover that it defies most methods of cleaning. The use of seed that is free of dodder is the best way to control it.

Johnson grass, another limited weed, was not in excess in any of the 14 crops studied, but was present in 1.46 percent of the lespedeza samples, and in 1.15 percent of the Sudan grass samples as may be expected owing to its striking similarity to Sudan. Although Johnson grass was a minor factor last year, due to its habits of growth, it might well become a very serious one later.

Wild bromegrass was the most prevalent of the noxious weeds, and was found in 81.44 percent of the cultivated bromegrass. Screening and blowing will remove this weed from some of the larger seeded crops but generally is ineffective in cultivated brome.

Curled dock is the next in importance of the noxious weeds, since it was present in 56.87 percent of the sweet clover samples. Here again the similarity in size of the weed seed to the crop seed makes it hard to clean from the crop seed.

Horse nettle was not found as often as wild bromegrass and curled dock but ranks third in the noxious weed series. It was present in 11 of the crops studied but in small amounts, as a rule.

Wild mustard was present in 26.13 percent of the flax samples and in minor amounts in nine of the remaining crops. Annual morning glory was found in 16.36 percent of the soybean samples and in small amounts in five other crops. It was found that 1.20 percent of the oats samples contained hedge bindweed while only two other crops were found to contain any of it. Buckhorn plantain was noted in 7.33 percent of the red clover samples but in no other crop.

Common weeds were numerous in both kind and amount, but were of lesser importance than noxious weeds. They are more harmful to the seed grower but lower the purity in the same manner as do inert matter and other crops.

Green foxtail was the most important common weed, being present in 61.49 percent of the alfalfa samples and ranging down to 0.32 percent in the wheat samples. A size correlation seems to be the main cause of the presence of green foxtail in certain crops.

Pigweed follows green foxtail and is the most common in Sudan grass, in 45.12 percent of the samples, although better screening should remove most of it. Millet and alfalfa have the second and third highest amounts of pigweed, but this was to be expected since there is a great similarity in the size of the seeds.

Switchgrass was the third most prevalent common weed in the 14 crops. It was present in 52.19 percent of the lespedeza samples, ranging downward through the other crops.

Lambsquarter, Brown-eyed Susan, Pennsylvania smartweed, large crabgrass, barnyard grass, and wild buckwheat make up the six most common weeds found. There were 75 species of common weeds found in these crops in Kansas last year. Table 6 shows their relative abundance and importance.

Weeds, then, are divided into four classes according to their importance, prohibited weeds, limited weeds, noxious weeds, and common weeds. They are considered the most important of the major factors in the purity of seeds for the reasons already given.

While there are many reasons for the presence of weed seeds in the crops, a study of the crops in which they are present reveals a decided correlation between the size and shape of the crop seed and that of the weed seed. When the size and the shape are nearly the same it is impossible to remove the weeds with any conventional type of cleaner. However, by using the proper size sieves, the crops will be much better cleaned than were some of those examined.

Roguing the field, sowing in a clean seed bed, and sowing pure seed will help to eliminate weeds but it is beyond the scope of this discussion to explain this phase.

Other crops ranked third of the major factors. In purity testing other crops discount in direct proportion to their weights, but from the farmer's standpoint they may be much more important. They cut down on the crop yields and raise production costs. In some instances, they may even prevent the crop from being certified although it may be eligible otherwise.

Sweet clover appeared more frequently than any of the other crops. It was present in 46.50 percent of the bromegrass samples, and in fairly substantial amounts in most of the other 13 crops. Apparently this is because sweet clover is hard to eradicate from a field after it has been used in a rotation.

Alfalfa was the second greatest of the other crops found, being noted in 13 of the crops. Red clover had the most with 21.34 percent. It, too, seems to be present in such large amounts because it is also used as a rotation crop.

Sorghum was third on the list of other crops. The test revealed that 50.47 percent of the sorghum samples had other types of sorghum in them and 39.25 percent of the Sudan samples had sorghum in them.

Rye, lespedeza, Sudan, wheat, flax, bromegrass and oats were present in much smaller amounts than the top three. Thirty other crops were present all together in this study.

Even though there was more inert material than any other major factor, the writer believes it should be considered of least importance, because it will not grow, but merely diluted the pure seed. Much of the inert material could be eliminated by careful blowing and screening. The inert material that cannot be removed by careful cleaning procedure will not cause much trouble in farming operations.

Weeds are the most important factor due to the danger of the spreading of weeds with the crop, in addition to the lowering of yields and raising the production costs. Prohibited weeds by definition should have caused the greater loss but due to the fact that limited weeds were so abundant they did the most damage.

Noxious weeds are next in importance due to their habit of growth. They are followed by common weeds for much the same reason.

Other crops were a more important factor than inert material due to certain characteristics, mainly that they will reproduce and become worse if not controlled.

Therefore weeds are most important, other crops second, and inert material last of the major factors.

SUMMARY

The base population of this study was sample lots for 1945-46 sent to the Kansas State Seed Laboratory, Manhattan, Kansas of the following crops: alfalfa, barley, bromegrass, flax, lespedeza, millet, oats, red clover, rye, sorghum, soybeans, Sudan grass, sweet clover and wheat.

Purity analysis was made on the crops and the results used to determine the average percent impurities per sample, the percent of samples containing impurities, and the most prevalent impurities. The percentage of weeds, inert, and other crops, in addition to other calculations were also necessary for this study.

The major factors in purity testing are weed seeds, other crops, and inert material. Inert material was present in the greatest amounts, weed seeds next, and other crops last. However, due to certain characteristics of the other two factors, weeds prove the most harmful, followed in order by other crops and inert.

Inert material was present in all samples of all crops, and in the greatest average amounts per crop. The ten most prevalent inert materials were: cracked seed, glumes, stems, soil, chaff, leaves, excreta, hulls, awns, and pods. Bromegrass contained the largest amount of inert material.

Weeds were second in abundance. Prohibited weeds found were field bindweed and hoary cress. Limited weeds found were dodder and Johnson grass. In addition to dodder and Johnson grass, ten species of noxious weeds were present: wild bromegrass, curled dock, bull nettle, wild mustard, annual morning glory, hedge bindweed and buckhorn plantain. Seventy five species of common weeds were found. The following were included in the first ten: green foxtail, pigweed, switchgrass, lambsquarter, Brown-eyed Susan, smartweed, Pennsylvania smartweed, large crabgrass, barnyard grass, and wild buckwheat. Bromegrass contained the highest average percentage weeds.

Other crops were least in abundance of the major factors. Sweet clover was most abundant of the other crops, followed by alfalfa, sorghum, rye, lespedeza, Sudan grass, wheat, flax, bromegrass, oats, and red clover. Bromegrass contained the highest average percentage of other crops.

Screens and sieves were studied and summarized in Table 2.

Although the similarity in size accounted for a major portion of the impurities, the proper use of screens and blowers could remove much of the impurities. Good cultural practices and the use of pure seed could all improve the purity of crop seeds.

Weeds were the most important major impurity, and dodder was the most important single weed.

Other crops were second in importance and sweet clover was their most important constituent.

Inert material was less harmful and cracked seeds were its prevalent factor.

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BIBLIOGRAPHY

Banton, Ronald
Problems in cleaning seeds. A.T. Ferrel and Co. p. 1-4, 1946.

Gates, F. C.
Weeds in Kansas. Kans. State Bd. Agr. p.51-327, 1941.

Kansas noxious weed laws. Kans. State Bd. Agr. p.1-4, 1945.

Kansas seed law. Kans. State Bd. Agr. p. 1-4, 1943.

The seed testing primer. Kans. State Bd. Agr. p. 7-62, 1940.

Mc. Laughlin, F. A.
Seed inspection. Mass. Agr. Expt. Sta. Bul. 111, p. 1-6, 1941.

Musil, A. F.
Testing farm seeds in home and school. U.S.D.A. Misc. Pub. 437, p. 1-88, 1942.

Rules for seed testing. N.Y. State. Agr. Circ. 73, p. 1-84, 1924.

Norris, E. L.
Testing seeds for purity. Kans. State Bd. Agr. p. 29-37, 1924.

Reports of seed tests. N. Car. Dept. Agr. Bul. 175, p. 1-8, 1912.

Stewart, Geo.
The seed situation in Utah. Utah Agr. Expt. Sta. Bul. 23, p. 1-27, 1916.

Rules and recommendations for testing seeds. U.S.D.A. Cir. 480, p. 1-52, 1938.

Zahnley, J. W.
Twenty-first Annual Report. Kansas State Seed Laboratory. Kans. State Bd. Agr. p. 1-10, 1941.